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Use RED OAK *and* HICKORY *for* PICNIC TABLES

U.S. FOREST SERVICE RESEARCH PAPER CS-6
Department of Agriculture
Central States Forest Experiment Station — Columbus, Ohio
July 1963

The Author

GLENN A. COOPER has seen both hardwoods and softwoods in his experience with the U.S. Forest Service. Before joining the Central States Station in 1959 with an M.S. in wood technology earned at Iowa State University, Glenn worked in the Pacific Northwest in 1956 and 1957 for the National Forests. His work as a Forest Products Technologist at the Station's Wood Products Pilot Plant near Carbondale, Illinois has been mainly concerned with hardwood utilization and product development.

This study is being made cooperatively with Southern Illinois University, which contributed to Pilot Plant facilities; and with the Shawnee National Forest, the Wayne-Hoosier National Forest, and the U.S. Fish and Wildlife Service where service-testing of the tables is underway.

Central States Forest Experiment Station, U.S. Dept. of Agriculture
Forest Service, 111 Old Federal Building, Columbus 15, Ohio
R. D. Lane, Director

GLENN A. COOPER . . .

Use RED OAK *and* HICKORY *for* PICNIC TABLES

Hardwoods have seldom been used in the manufacture of picnic tables, perhaps because the less dense softwoods are generally considered to lend themselves more readily to woodworking. But the high density of hardwoods may actually be a distinct advantage in picnic tables for use on campgrounds and recreation areas because it discourages carving and other vandalism. The weight of oak or hickory tables (about 325 pounds or roughly 100 pounds more than softwood tables) makes it more difficult to move them from designated sites.

Another advantage of hardwoods for picnic tables is the relatively low cost of the lumber. Seventy-two standard-type, 7-foot National Forest picnic tables were produced experimentally, using equipment usually found in a medium-size woodworking shop, at a cost of less than $31 per table for materials and direct labor.

The market for hardwood lumber for manufacture of heavy-duty picnic tables could be a large one because the public demand for outdoor recreation is increasing. In 1960, the U.S. Forest Service anticipated that recreational use of the National Forests would increase 700 percent by the year 2000.[1] The estimates also indicated a use for picnic tables at 30,000 campgrounds or picnic sites that need to be constructed or rehabilitated by 1972. Other public agencies, and private-land owners too, will be expanding recreation facilities.

A 7-foot picnic table, built according to Forest Service specifications to withstand rough use on public areas, contains about 100 board feet of wood parts. Thus, the picnic tables needed by the Forest Service to complete its 10-year program, excluding replacements for tables that become unserviceable, will require about 30 million board feet of lumber. Assuming 60 percent utilization from the tree to the finished table, almost 50 million board feet of sawtimber would be needed. With needs of other agencies and the development of private recreation areas, clearly a large volume of timber will be required for picnic tables.

The manufacture of hardwood picnic tables could result in new or expanded woodworking plants which would contribute to improved employment and economic conditions throughout the rural areas where hardwood forests grow.

This publication reports the methods successfully used in the production of tables from red oak and hickory and the costs for labor and materials. To evaluate their durability and utility, the tables were placed on campgrounds in the Crab Orchard National Wildlife Refuge in southern Illinois and National Forests in Ohio, southern Illinois, and southeastern Missouri. Performance of the tables in these locations and the success of preservative treatments will be reported in a later publication.

[1]U.S. Forest Service. Development program for the National Forests. U.S. Dept. Agr. Misc. Pub. 896, 26 pp., illus. 1961.

FIGURE 1.—An experimental modified National Forest picnic table built from No. 2 Common hickory lumber. Note that narrow planks are used in the top and seats.

Production Methods

To study methods and costs of production, we produced 72 tables from red oak and hickory lumber (fig. 1). These are standard Forest Service light-plank tables (fig. 2) modified slightly for the use of hardwood lumber (appendix, p. 19). They are sturdy and designed for rough use. All parts are of 2-inch lumber except the legs which are 4 inches square.

In the 72 hardwood tables, we used No. 2 Common and No. 3A Common grades[2] of 8/4-inch red oak and hickory lumber in random widths. Preliminary examination of 8/4 red oak and hickory lumber 8 to 16 feet in length indicated that the highest yield and best balance of parts for 7-foot tables could be obtained from 14-foot lumber. To check this, the cost of table parts from 14-foot lumber was compared with that from random-length lumber. Equipment usually found in a medium-size woodworking shop (appendix, p. 19) was used to produce tables from:

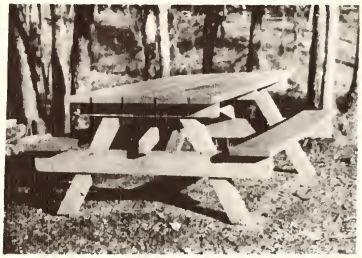
No. 2 Common, random-width, random-length lumber (12 tables)
No. 2 Common, random-width, 14-foot-length lumber (6 tables)
No. 3A Common, random-width, random-length lumber (12 tables)
No. 3A Common, random-width, 14-foot-length lumber (6 tables)

All legs were made from Sound Square Edge grade[3] timbers — half from red oak and half from hickory. Lumber and timbers were all air dried to less than 19 percent moisture content.

[2]As established by National Hardwood Lumber Association. Rules for measurement and inspection of hardwood lumber. 126 pp., Chicago 5, Illinois. 1961.

[3]These timbers were supplied by a local mill operator who defines the Sound Square Edge grade as being free of wane, unsound defects, shake, and pith.

FIGURE 2. — Plan for Forest Service light-plank table.



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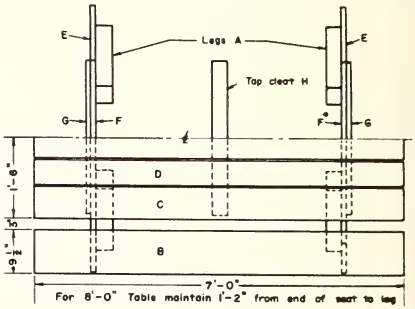
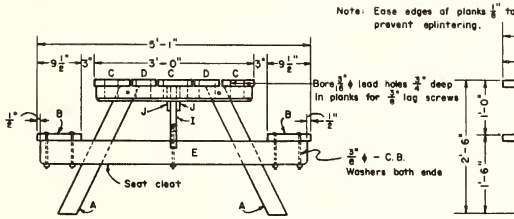
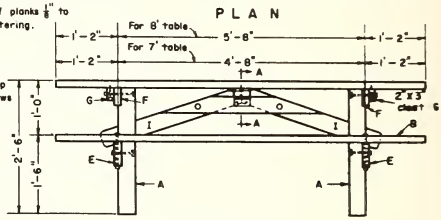
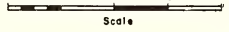




END VIEW



SIDE VIEW



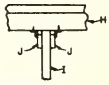
SPECIFICATIONS

Use most economical durable species available (See Wood Handbook, U.S.D.A. Handbook No. 72), preferably heartwood cuts. Lumber shall be equivalent to West Coast Lumberman's Association "Construction" grade for Douglas Fir. Lumber shall have a moisture content, prior to treatment, of not to exceed 20% in the outer half inch.

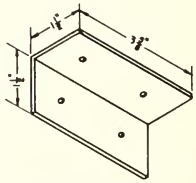
After all cutting and boring is completed, all table parts shall be given a preservative treatment by soaking for 48 hours in a water repellent preservative certified as conforming to composition A (pentachlorophenol) of Federal Specification TT-W-572, 'Wood Preservative, Water Repellent.' One brush coat of Forest Products Laboratory Natural Finish, colored to Regional Standards, shall be applied after assembly. The interval between treating and applying the finish shall be such that the surface shall be free from waxy, greasy, oily, or crystolline deposits removable by rubbing with the fingers, free from any glossy film resembling that of varnish, and free from any easily detectable odor of treating solvent. If the only surface contamination is in the form of a few dry crystals that can readily removed by brushing, finishing may be permitted if the surfaces are brushed clean.

Wood seat and top planks shall be installed with the heart side down.

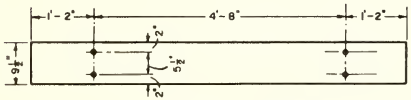
Before mass production of this unit is started, a pilot model should be cut and assembled to assure proper dimension and fit.



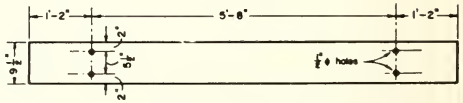
SECTION A-A



GALV. CLIP
(1 1/8" x 1 1/4" x 3 5/8" x 18 ga.)



SEAT PLANK (7' Table)
(Make 2 from 2"X10"X 7'-0" S4S)



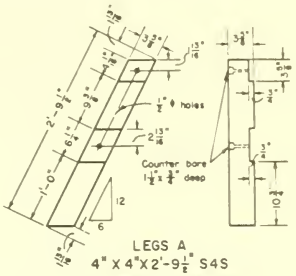
SEAT PLANK (8' Table)
(Make 2 from 2"X10"X 8'-0" S4S)

FOREST SERVICE

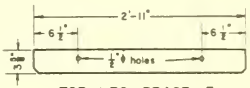
LIGHT PLANK TABLE

PLATE IIA SHEET 1 OF 2
OCTOBER 1960
Supercedes Plate II A
July 1959

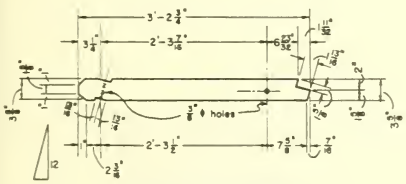
MATERIAL LIST					
7 FOOT TABLE	NO.	FINISH	NAME AND USE	MARK	8 FOOT TABLE
4"X4"X2'-9 1/2"	4	S4S	Legs	A	4"X4"X2'-9 1/2"
2"X10"X7'-0"	2	S4S	Seat planks	B	2"X10"X8'-0"
2"X8"X7'-0"	3	S4S	Top planks	C	2"X8"X8'-0"
2"X6"X7'-0"	2	S4S	Top planks	D	2"X6"X8'-0"
2"X6"X5'-0"	2	S4S	Seat cleats	E	2"X6"X5'-0"
2"X4"X2'-11"	2	S4S	Top leg brace	F	2"X4"X2'-11"
2"X3"X2'-11"	2	S4S	Top cleat	G	2"X3"X2'-11"
2"X4"X2'-11"	1	S4S	Top center cleat	H	2"X4"X2'-11"
2"X4"X2'-8 7/8"	2	S4S	Brace	I	2"X4"X3'-2 3/4"
1"X4"X 3'-8"	2	S4S	Gusset plate	J	1"X4"X3'-8"
1/2"X10"	2	Galv.	Carriage bolts brace		1/2"X10"
5/8"X8"	8	Galv.	Carriage bolts seats		5/8"X8"
1/2"X7"	4	Galv.	Carriage bolts top to legs		1/2"X7"
1/2"X5"	4	Galv.	Carriage bolts (SEAT CLEAT TO LEGS)		1/2"X5"
3/8"X4"	2	Galv.	Carriage bolts gusset plate		3/8"X4"
5/16"X3"	30	Galv.	Lag screws-cleats to top		5/16"X3"
Cut washers	42	Galv.	1/2" Dia. bolts		Cut washers
Cut washers	8	Galv.	5/8" Dia. bolts		Cut washers
Cut washers	12	Galv.	To fit sq. end (1/2" DIA. CARRIAGE BOLTS)		Cut washers
Cut washers	8	Galv.	To fit sq. end (5/8" DIA. CARRIAGE BOLTS)		Cut washers
Clips	2	Galv.	1 1/2"X1 1/2"X18ga.X3 5/8"		Clips
Nails	8	Galv.	3 Penny		Nails



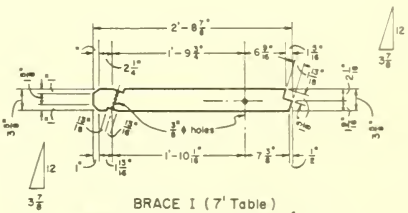
LEGS A
4" X 4"X 2'-9 1/2" S4S
(2 as shown, 2 opp. hand)



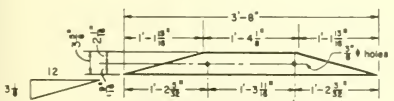
TOP LEG BRACE F
(Make 2 from 2"X4"X2'-11" S4S)



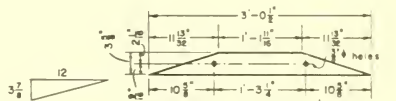
BRACE I (8' Table)
(Make 2 from 2"X4"X3'-2 3/4" S4S)



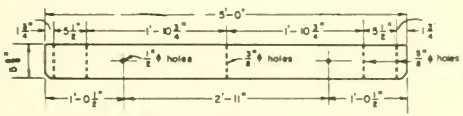
BRACE I (7' Table)
(Make 2 from 2"X4"X2'-8 7/8" S4S)



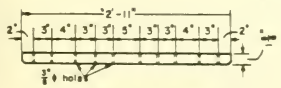
GUSSET PLATE J (8' Table)
(Make 2 from 1"X4"X3'-8" S4S)



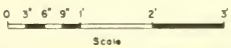
GUSSET PLATE J (7' Table)
(Make 2 from 1"X4"X3'-0 1/2" S4S)

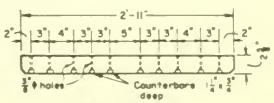


SEAT CLEAT E
(Make 2 from 2"X6" X 5'-0" S4S)



TOP CENTER CLEAT H
(Make 1 from 2"X4"X2'-11" S4S)





TOP CLEAT G
(Make 2 from 2"X3"X 2'-11" S4S)

FOREST SERVICE

LIGHT PLANK TABLE

PLATE IIA SHEET 2 OF 2
OCTOBER 1960
Supercedes Plate II A
July 1959

Rough and Finish Milling

Rough 8/4-inch lumber was first sorted into rip- and crosscut-type boards based on width, location of defects, and the amount of cup in the board. The rip-type boards were preripped and combined with the crosscut-type boards at the cutoff saw. All of the lumber was crosscut with a swinging-arm cutoff saw (fig. 3), surfaced two sides to 1⅝ inches on a 30-inch single surfacer (two passes), and ripped on a power-fed ripsaw. The material was hand fed into each machine, taken by an offbearer, and handled between operations on factory trucks. Each operation was performed by a two-man crew. The cutoff sawyer tried to get the maximum yield of the longest parts until the lot quota of all parts was filled. Defects permitted in table parts were comparable to those allowed in Construction grade Douglas-fir lumber commonly used in picnic tables (appendix, p. 20).

Table legs were rough milled from the 4- by 4-inch timbers by crosscutting and surfacing four sides. Crosscutting was done on the swinging-arm cutoff saw; surfacing was accomplished by planing two opposite faces, jointing one adjacent face, and then planing the fourth face.

Finish milling of table parts was done with an adjustable radial-arm saw, a table saw, a bandsaw, and a single-spindle, floor-type drill press. Finish milling consisted of double-end-trimming all parts to finished length; cutting all necessary angles, notches, and bevels; and boring holes for bolts and screws with a positioning jig and portable, electric drills (fig. 4). Where there were two or more ways for one or two men to perform these jobs, each was tried on a few table parts, and then the most efficient method was used to finish mill the rest of the parts.

Although all rough-milling operations required two men, several of the finish-milling operations proved most efficient as one-man jobs. The top and leg cleats were most easily angle-cut by one man using the table saw, and the notches and angles in braces were cut efficiently by one man using a bandsaw with at least a 24-inch throat. The longer seat cleats were too cumbersome for efficient end-trimming and angle-cutting on the table saw by one man, but two men using the radial-arm saw proved to be efficient. Two men at the radial-arm saw were also best for double-end-trimming the top and seat planks.

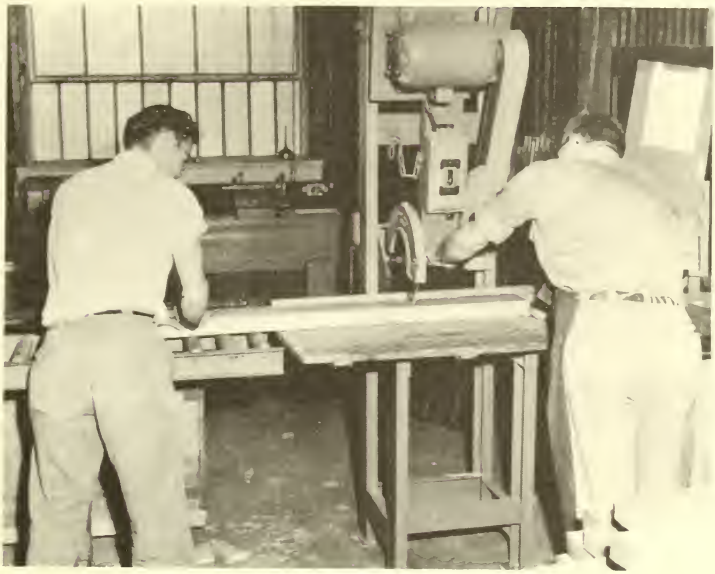


FIGURE 3. — Crosscutting the rough lumber to rough lengths on the swinging cutoff saw.

FIGURE 4. — Drilling boltholes in a pair of seat planks using portable tools and a jig for aligning the parts.

Chamfering of the edges of the top and seat planks was done on the tilting arbor table saw by two men. The end-chamfering was done by two men using jack planes. End-chamfering on power equipment required excessive handling of the pieces.

All notching and angle-cutting of the legs was done by two men with the radial-arm saw. A dado head was more efficient than a rafter notcher for cutting the notches for seat cleats.

The drilling of the tops and seats with portable tools and the positioning jig was done by two men. This was fast and accurate and only a minimum of handling was required. All other drilling was done by one man using a single-spindle, floor-type, foot-pedal-operated drill press. This was more efficient than having two men use a hand-operated drill press.

Input and output (yield) and production time to the nearest 0.01 minute were recorded for each operation in the production of the tables.

Treating, Assembling, and Staining

After all machining was completed, the table parts were dipped or cold-soaked in a water-repellent preservative, 5 percent pentachlorophenol in mineral spirits. They were treated from 3 minutes to 48 hours to learn the effectiveness of different treatments. When service trials are completed, the treatments will be evaluated and a report will be published.

All assembling and finishing was most easily done by a two-man crew. Although three or four men were used initially, it was found there were times when one or two men were idle or in the way of others and for most of the study only two men were used on each operation. Tables were assembled in two phases after the preservative carrier had evaporated enough to permit handling of the parts. First, the top planks were attached to the top cleats with lag screws. Then the understructures were bolted together and joined to the tops (figs. 5 and 6). These operations were performed by two men using portable, electric handtools. Finally, the tables were brushed with one coat of the Forest Products Laboratory natural finish[1] — cedar color with twice the amount of pigment specified.

[1]U.S. Forest Service. Forest Products Laboratory natural finish. U.S. Dept. Agr. Forest Prod. Lab. Rpt. 2096, 3 pp., illus. 1957.

FIGURE 5. — Placing the preassembled top on the understructure. (Photo courtesy of Southern Illinois University Information Service.)

FIGURE 6. — Driving leg bolts through the top cleats and leg. (Photo courtesy of Southern Illinois University Information Service.)

Tables made from No. 2 Common and No. 3A Common red oak and hickory lumber and Sound Square Edge timbers meet the requirements for appearance established by the defects allowed in Construction grade Douglas-fir lumber. Allowable defects were more numerous in table parts produced from No. 3A Common lumber than in parts produced from No. 2 Common lumber. But, in our opinion, these defects do not detract from either the appearance or the utility of the finished tables. Differences in color due to species and sapwood-heartwood contrasts are not apparent after the tables are finished.

Table Costs

The costs per table for materials and direct labor varied from $26.81 to $30.58 (table 1). Indirect costs that could vary greatly by individual manufacturing plants are not included. These include depreciation, maintenance of woodworking machinery, and plant, utilities, supervisory, and overhead costs.

The following figures for material and direct labor (taken from table 1) combine the costs of tables produced from random-length and 14-foot, fixed-length lumber:

No. 3A Common hickory — $26.81
No. 2 Common hickory — $28.23
No. 3A Common red oak — $29.78
No. 2 Common red oak — $29.90

Thus, tables made from No. 3A Common hickory cost the least, $1.42 per table less than from No. 2 Common hickory, $2.97 less than from No. 3A Common oak, and $3.09 less than from No. 2 Common oak.

These differences could be important for a large number of tables. They result because lumber and timbers vary in price by grades and species, in the quantity of table parts each grade yields, and in the amount of labor required to make the parts. For both species, tables made from No. 3A Common lumber cost less than tables made from No. 2 Common lumber though the differences were relatively small. Fewer (but not necessarily smaller) defects in table parts made from No. 2 Common may be important enough from the purchaser's viewpoint to warrant the greater cost. But the

TABLE 1. — Average costs of materials and direct labor per table (In dollars)

RED OAK

Materials	Grade and length of lumber			
	No. 2 Common		No. 3A Common	
	Random length	14-foot length	Random length	14-foot length
8/4-inch lumber[1]	12.47	13.85	12.48	13.17
4- by 4-inch timbers[1]	1.75	1.75	1.75	1.75
Hardware	7.38	7.38	7.38	7.38
Finishing stain	.44	.44	.44	.44
Preservative	.74	.74	.74	.74
Labor[2]	6.44	6.42	6.73	6.55
Total	29.22	30.58	29.52	30.03

HICKORY

8/4-inch lumber[1]	11.72	10.61	9.49	9.52
4- by 4-inch timbers[1]	1.54	1.54	1.54	1.54
Hardware	7.38	7.38	7.38	7.38
Finishing stain	.44	.44	.44	.44
Preservative	.74	.74	.74	.74
Labor[2]	7.03	6.89	7.22	7.19
Total	28.85	27.60	26.81	26.81

[1] Figures from table 2.
[2] At an average labor charge of $1.45 per hour (from table 3).

important point here is that satisfactory tables can be produced at reasonable cost from No. 3A Common red oak or hickory lumber. So here is a market for timber or lumber that timber owners, timber managers, and sawmill operators now find difficult to sell.

Yield of Table Parts and Cost of Lumber and Timbers per Table

Prices per thousand board feet used in this study for air-dry lumber delivered to our plant were:

	Red oak	*Hickory*
8/4 No. 3A Common, random length	$70.00	$48.00
8/4 No. 2 Common, random length	80.00	63.00
8/4 No. 3A Common, 14 feet	80.00	58.00
8/4 No. 2 Common, 14 feet	90.00	73.00
4- by 4-inch Sound Square Edge, 8-12 feet	85.00	75.00

The cost of lumber and timbers per table and the yield of table parts varied with species, grade, and length. It was as little as $11.03 per table for No. 3A Common, random-length, hickory lumber and hickory timbers and as much as $15.60 for No. 2 Common, 14-foot red oak lumber and red oak timbers (table 2).

The No. 2 Common lumber of both species gave a better yield of table parts than No. 3A, but not enough better to offset its greater cost. This was true for both random-length and 14-foot, fixed-length lumber.

TABLE 2. — Yield of table parts and cost of lumber and timbers

Grade, thickness, and length	Yield	Input required for 12 tables	Price per thousand board feet delivered	Cost for 12 tables	Cost per table[1]
	Percent	Board feet	Dollars	Dollars	Dollars
RED OAK					
No. 2 Common, 8/4-inch, random-length lumber	50.92	1,870	80.00	149.60	12.47
No. 2 Common, 8/4-inch, 14-foot-length lumber	51.59	1,846	90.00	166.14	13.85
No. 3A Common, 8/4-inch, random-length lumber	44.52	2,139	70.00	149.73	12.48
No. 3A Common, 8/4-inch, 14-foot-length lumber	48.19	1,976	80.00	158.08	13.17
Sound Square Edge, 4- by 4-inch, 8-12 feet timbers	75.00	247	85.00	21.00	1.75
HICKORY					
No. 2 Common, 8/4-inch, random-length lumber	42.64	2,233	63.00	140.68	11.72
No. 2 Common, 8/4-inch, 14-foot-length lumber	54.60	1,744	73.00	127.31	10.61
No. 3A Common, 8/4-inch, random-length lumber	40.15	2,372	48.00	113.86	9.49
No. 3A Common, 8/4-inch, 14-foot-length lumber	48.35	1,969	58.00	114.20	9.52
Sound Square Edge, 4- by 4-inch, 8-12 feet timbers	75.00	247	75.00	18.53	1.54

[1] To determine the total cost per table, add the cost of the 8/4-inch lumber to the cost of the 4- by 4-inch timbers of the same species.

Comparing the different lengths, the higher priced, 14-foot lumber of both species gave the better yield of table parts. But only for No. 2 Common hickory was the yield of 14-foot lumber enough better to offset its greater cost.

Long table parts (5 and 7 feet) were the most difficult to obtain in the quantity needed. Fixed-length lumber that was less than 14 feet 2 inches long did not yield two 7-foot pieces plus end-trim allowance; thus the anticipated increase in yield from using 14-foot boards did not occur. If 14-foot boards with a 2-inch or longer trimming allowance cannot be obtained, the long parts can be obtained from 14-foot stock, with no sacrifice in utility of the picnic tables, by shortening the tops and seats by 1 inch. This makes it possible to cut two parts from a 14-foot board.

Another possibility for lowering the cost of hardwood tables is to use Sound Square Edge lumber and timbers. This grade of thick oak and hickory is often easier to obtain from local sawmills than the No. 2 and No. 3A Common factory grades, and we have found that the Sound Square Edge grade contains some boards equivalent to No. 1 Common or better factory-grade lumber. This makes it easier to obtain the longer cuttings for the tabletop and seat planks. The Sound Square Edge grade in random lengths costs about the same as No. 2 Common lumber of fixed length.

Other Material Costs

Cost of material other than lumber depends on the size and design of the table. This is true of hardware, finishing materials, and the preservative (table 3). Hardware costs averaged $7.38 per table for galvanized bolts, nuts, washers, and lag screws for the 7-foot tables we produced. The tables required an average of 0.2 gallons of the natural-finish stain at a cost of $2.22 per gallon, or $0.44 per table. Because treating time was purposely varied, the cost of preservative could not be fixed and only an average can be given. In this study the average cost of preservative was $0.74 per table.

TABLE 3. — Material costs (except lumber and timbers)

Hardware for 12 tables:			
600 3/8- x 3-inch galvanized lag screws	@ $ 4.11/C	=	$24.66
192 3/8- x 8-inch galvanized carriage bolts	@ 11.34/C	=	21.77
24 3/8- x 9-inch galvanized carriage bolts	@ 22.78/C	=	5.47
48 1/2- x 7-inch galvanized carriage bolts	@ 19.61/C	=	9.41
48 1/2- x 5-inch galvanized carriage bolts	@ 12.82/C	=	6.15
45 pounds 3/8-inch galvanized washers	@ .44/pound	=	19.80
1 pound 2-inch galvanized washers	@ 1.25/pound	=	1.25
Total			$88.51
Cost per table			$ 7.38
Finish stain (materials for Forest Products Laboratory natural finish):			
15 gallons boiled linseed oil	@ $ 8.50/5 gallons	=	$25.50
6 quarts burnt sienna	@ 1.06/quart	=	6.36
6 quarts raw umber	@ 1.44/quart	=	8.64
5 pounds paraffin wax	@ .25/pound	=	1.25
10 ounces zinc stearate	@ .69/ounce	=	6.90
5 gallons mineral spirits	@ .27/gallon	=	1.35
2 1/2 gallons 10:1 pentachlorophenol concentrate	@ 2.66/gallon	=	6.65
Total (25 1/2 gallons)			$56.65
Total cost per gallon			$ 2.22
Average cost per table	@ $ 0.2 gallon/table		$ .44
Treating solution (dip and soak treatment):			
80 gallons 5 percent solution of water-repellent pentachlorophenol in mineral spirits for 72 tables	@ $ 0.67/gallon	=	$53.60
Average cost per table		=	$ .74

Labor Costs

At an average of $1.45 per hour each for a laborer and a semiskilled craftsman, the total cost of direct labor per table ranged from $6.42 to $7.22. From the standpoint of labor cost, the cheapest lumber to convert to table parts was the No. 2 Common, 14-foot red oak and the most expensive was the No. 3A Common, random-length hickory (table 4).

The grade, species, and length of lumber used made a difference in the amount of labor required. However, parts for a lot of 12

TABLE 4. — Labor required to produce picnic tables (In man hours for 12 tables)

RED OAK

Operations	Grade and length of lumber			
	No. 2 Common		No. 3A Common	
	Random length	14-foot length	Random length	14-foot length
Rough milling 8/4	9.71	9.58	12.20	10.72
Finish milling 8/4[1]	12.09	12.09	12.09	12.09
Leg milling[1]	4.42	4.42	4.42	4.42
Top subassembly[1]	6.62	6.62	6.62	6.62
Assembly[2]	8.64	8.64	8.64	8.64
Finishing[2]	8.91	8.91	8.91	8.91
Treating[2]	2.84	2.84	2.84	2.84
Total man hours for 12 tables	53.23	53.10	55.72	54.24
Man hours per table	4.44	4.43	4.64	4.52
(Labor cost per table[3]	$ 6.44	$ 6.42	$ 6.73	$ 6.55)

HICKORY

Rough milling 8/4	11.10	9.94	12.71	12.45
Finish milling 8/4[1]	13.28	13.28	13.28	13.28
Leg milling[1]	5.65	5.65	5.65	5.65
Top subassembly[1]	7.77	7.77	7.77	7.77
Assembly[2]	8.64	8.64	8.64	8.64
Finishing[2]	8.91	8.91	8.91	8.91
Treating[2]	2.84	2.84	2.84	2.84
Total man hours for 12 tables	58.19	57.03	59.80	59.54
Man hours per table	4.85	4.75	4.98	4.96
(Labor cost per table[3]	$ 7.03	$ 6.89	$ 7.22	$ 7.19)

1/ Based on average hours of labor for 36 tables.
2/ Based on average hours of labor for 72 tables.
3/ Labor cost at $1.45 per hour.

tables could be rough milled from No. 2 Common lumber of either species in less time than from No. 3A Common lumber. It also took less time to rough mill parts from 14-foot lumber of either species than from random-length lumber.

Species differences were reflected in the man-hours of labor required throughout the milling and assembly operations. The higher density and hardness of hickory made the surfacing, sawing, boring, and handling of those parts slower than for red oak.

To produce tables efficiently, a medium-size shop should be equipped with a cutoff saw, straight-line ripsaw, jointer, surfacer, table saw, radial-arm saw, bandsaw, and a floor-type drill press. Our production equipment was adequate for the job. However, for a steady flow of parts in continuous production to avoid bottlenecks, more than one machine would be required for some operations. This is because the time requirements on each machine vary widely for the production of a given number of tables (table 5).

TABLE 5. — Machine hours required to produce parts for 12 picnic tables (In machine hours for 12 tables)

RED OAK

Operation and equipment	Grade and length of lumber			
	No. 2 Common		No. 3A Common	
	Random length	14-foot length	Random length	14-foot length
Rough milling[1]				
Ripsaw	1.59	1.43	2.06	1.70
Swinging cutoff saw	2.34	2.65	2.92	2.93
Planer	1.41	1.47	1.57	1.50
Jointer	.27	.27	.27	.27
Finish milling[2]				
Radial-arm saw	1.54	1.54	1.54	1.54
Bandsaw	.81	.81	.81	.81
Table saw	1.12	1.12	1.12	1.12
Drill press	5.89	5.89	5.89	5.89

HICKORY

Rough milling[1]				
Ripsaw	1.53	1.44	1.39	1.85
Swinging cutoff saw	2.63	2.28	3.62	3.24
Planer	1.69	1.65	1.61	1.65
Jointer	.32	.32	.32	.32
Finish milling[2]				
Radial-arm saw	1.60	1.60	1.60	1.60
Bandsaw	.81	.81	.81	.81
Table saw	1.29	1.29	1.29	1.29
Drill press	6.45	6.45	6.45	6.45

1/ Machine requirements for rough milling vary because different volumes of lumber are required in each grade and length, and more time is required to rough mill the harder and denser hickory than red oak.

2/ Machine requirements for finish milling vary only with wood properties because surface areas are equal.

Summary

Seventy-two standard-type National Forest picnic tables were produced from red oak and hickory by methods feasible in a medium-size woodworking shop to determine the cost of production. No. 2 Common and No. 3A Common lumber of both species gave satisfactory yields at low production costs. An acceptable table can be built for less than $31.00 plus indirect labor, machine, and overhead charges. The cost of the tables is low enough to encourage the use of low-grade hardwood lumber in the manufacture of heavy-duty durable tables for campgrounds and recreation areas.

Appendix

Design Changes

The standard light-plank Forest Service table that was used as a basic design for the experimental tables is shown in figures 1 and 2. The changes made in the standard plan were primarily in the nominal dimensions of top and seat planks. In lieu of three planks 2 by 8 inches and two planks 2 by 6 inches in the top, the experimental tables have three planks 2 by 6 inches and four planks 2 by 4 inches with a ⅜-inch spacing. Also, the seat has been altered from one plank 2 by 10 inches to two planks 2 by 5 inches spaced ⅜ inch apart. Another change was the elimination of the galvanized clips and gusset plates. Instead, lag screws were used to attach the braces directly to the top center cleat. With these modifications the 7-foot table contains a net volume of 98 board feet of lumber.

Equipment Used in Table Production

Swinging cutoff saw, 14-inch blade, 3-hp. motor

Single-surface cabinet planer, 4-knife head, 30 inches wide, 15-hp. motor

Straight-line, power-feed ripsaw, 14-inch blade, 20-hp. motor on arbor

Tilting arbor, table saw, 16-inch blade, 7½-hp. motor on arbor

Heavy-duty jointer, 3-knife head, 16 inches wide, 5-hp. motor on arbor

Bandsaw, 29-inch throat, 3-hp. motor

Radial-arm saw, 18-inch blade, 5-hp. motor

Fork-lift truck, 6,000-pound capacity

Single-spindle, floor-type drill press, foot-pedal-operated, ½-hp. motor

Dip-treating tank

Eight factory hand trucks

Miscellaneous portable hand and power tools

Allowable Defects

Construction grade Douglas-fir is specified for the Forest Service light-plank table (fig. 1). To accommodate red oak and hickory lumber, grading rules for Douglas-fir[5] were departed from slightly. Defects permitted in the 8/4-inch table parts were:

Stained sapwood

Stained heartwood in 25 percent of the piece

End checks up to 4 inches long

Pinholes, shotholes, and wormholes not over ¼ inch in diameter.

Ordinary seasoning checks

Slope of grain not exceeding 1 in 10

Occasional skip 1/16 inch deep by 2 feet long

Wane not over 1 inch wide and half the length on one edge

Sound, tight knots up to 1¼ inches in diameter on 3-inch parts and 1½ inches in diameter on wider parts

Pith, shake, or raised grain, rot, and open bark pockets were not permitted in the planks. The legs were free of pith, shake, and rot but the following defects were permitted:

Wane up to 1 inch wide on any face, and full length

Intergrown or tight knots up to 1 inch in diameter

Pinholes, shotholes, and spot wormholes

Other holes up to ¼ inch in diameter

Burls, stain, streak, and season checks

[5]West Coast Lumbermen's Association. Standard grading and dressing rules for Douglas fir lumber. 338 pp., illus., Portland, Oregon. 1956.

Agriculture — Forest Service — Columbus, Ohio

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